

8EHQ-90-373  
AR226-3883

3M

**Certified Mail**

December 15, 2008

Document Processing Center  
EPA East – Room 6428 Attn: Section 8(e)  
Office of Pollution Prevention and Toxics US EPA  
1200 Pennsylvania Avenue NW  
Washington DC 20460-0001

No CBI



RE: TSCA 8(e) ADDITIONAL INFORMATION SUBMISSION for Sulfonate-based and  
Carboxylic-based Fluorochemicals: Docket No. 8EHQ-1180-373

To whom it may concern:

Enclosed please find the presentation *Analysis of the Homologous Series of Perfluorocarboxylates – Perfluorobutanoate (C4) through Perfluorododecanoate (C12) from American Red Cross Adult Blood Donors, 2006*, by Geary Olsen, Mark Ellefson, and William Reagen. This presentation was prepared for the SETAC North American 29<sup>th</sup> annual meeting and presented on November 19, 2008.

The data provided in the presentation focus on plasma C4 – C12 perfluorocarboxylate levels in samples collected in 2006 from donors in six different US locations. Comparisons are made to a similar set of data from samples collected in 2000. Declines were previously noted from 2000 – 2006 for perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) (see Olsen et al. ES&T 2008; 42:4989-4995). In the presentation submitted herein, plasma concentrations for perfluorononanoate (PFNA), perfluorodecanoate (PFDA), and perfluoroundecanoate (PFUnDA), appeared to have increased. Strong correlations were also observed between higher chain lengths and weak correlations were observed between higher and lower chain lengths. Perfluorobutyrate (PFBA) was also measured and appeared to have declined between 2000 and 2006.

Please note that 3M historically did not manufacture, and does not currently produce, the higher homologs or their precursors. 3M does not believe that any of these data taken alone or cumulatively meet the “substantial risk” reporting threshold as defined by EPA. We nevertheless recognize the on-going work of the U.S. EPA to assess fluorochemical exposure pathways. Therefore, we are placing these results in the 8(e) docket as a supplement to previous submissions.

If you have any questions or would like any additional information, please contact Deanna Luebker at (651) 737-1374 or [djluebker@mmm.com](mailto:djluebker@mmm.com).

Sincerely,

*Jean B. Sweeney (HLS)*

Jean B. Sweeney  
Staff Vice President, 3M Environmental, Health and Safety Operations

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TSCA CONFIDENTIAL  
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MR#316017

# Analysis of the Homologous Series of Perfluorocarboxylates – Perfluorobutanoate (C4) through Perfluorododecanoate (C12) from American Red Cross Adult Blood Donors, 2006

## SETAC

### North America

29<sup>th</sup> Annual Meeting  
Tampa Bay, Florida  
November 19, 2008

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Mark Ellefson<sup>2</sup>

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<sup>1,2</sup>3M Company, <sup>1</sup>Medical Department, <sup>2</sup>Environmental Laboratory

09 DEC 29 AM 10:07

# Acknowledgements

- **3M**
  - John Butenhoff
  - Sue Chang
  - Larry Zobel
- **American Red Cross**
  - David Mair
  - Theresa Boyd
  - Ross Herron
  - Zahra Medhdizadehkashi
  - John Nobiletti
  - Jorge Rios
- **University of Minnesota**
  - Tim Church

# Methods

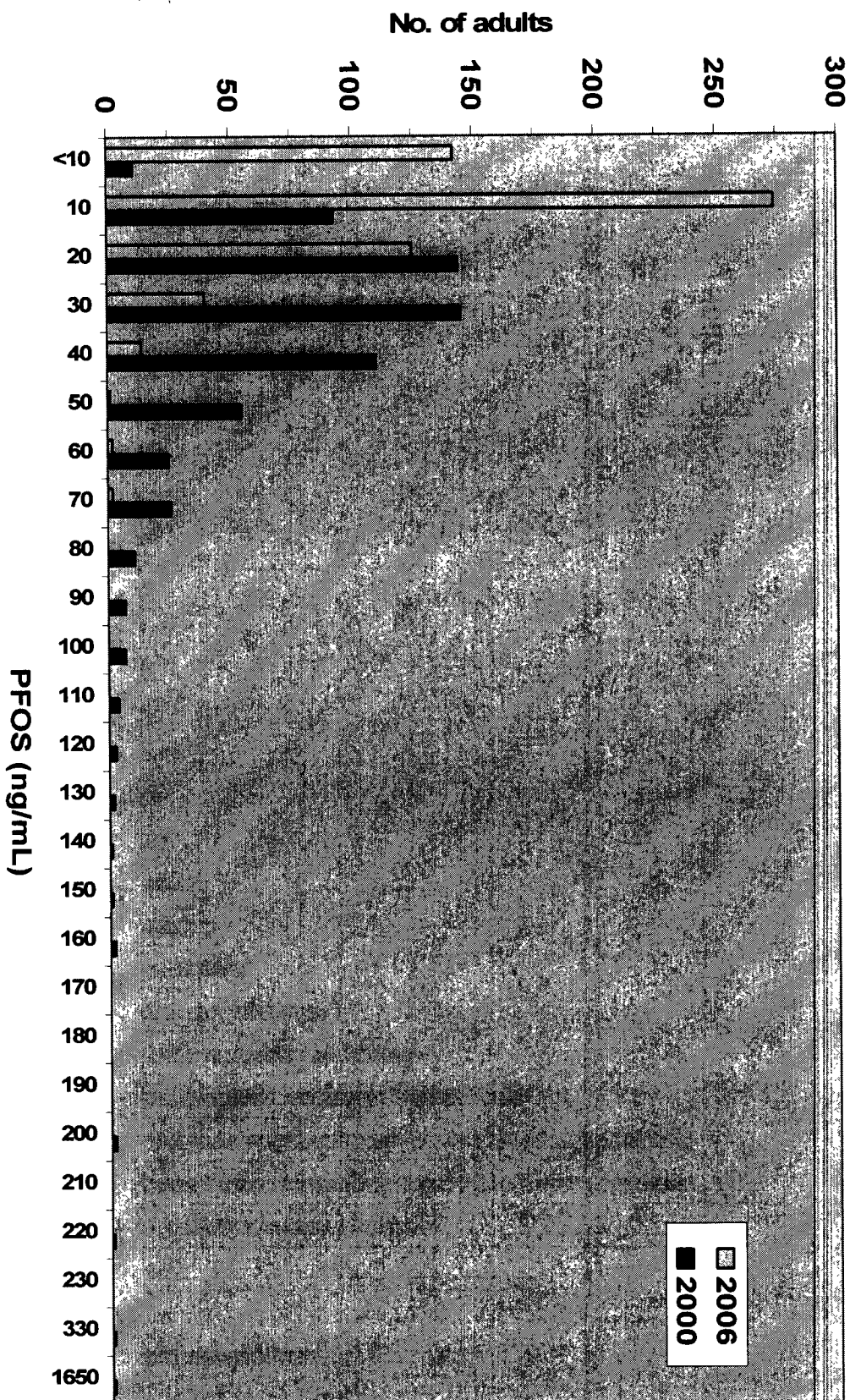
(Olsen et al. ES&T 2008;42:4989-4995

- Study design
  - Total of 600 plasma samples collected
    - 100 plasma samples were collected between May and July 2006 in each of six locations
      - Boston, MA; Charlotte, NC; Hagerstown, MD; Los Angeles, CA; Mpls-St.Paul, MN; Portland, OR.
  - 10 samples per each sex and age group
    - 20-29
    - 30-39
    - 40-49
    - 50-59
    - 60-69

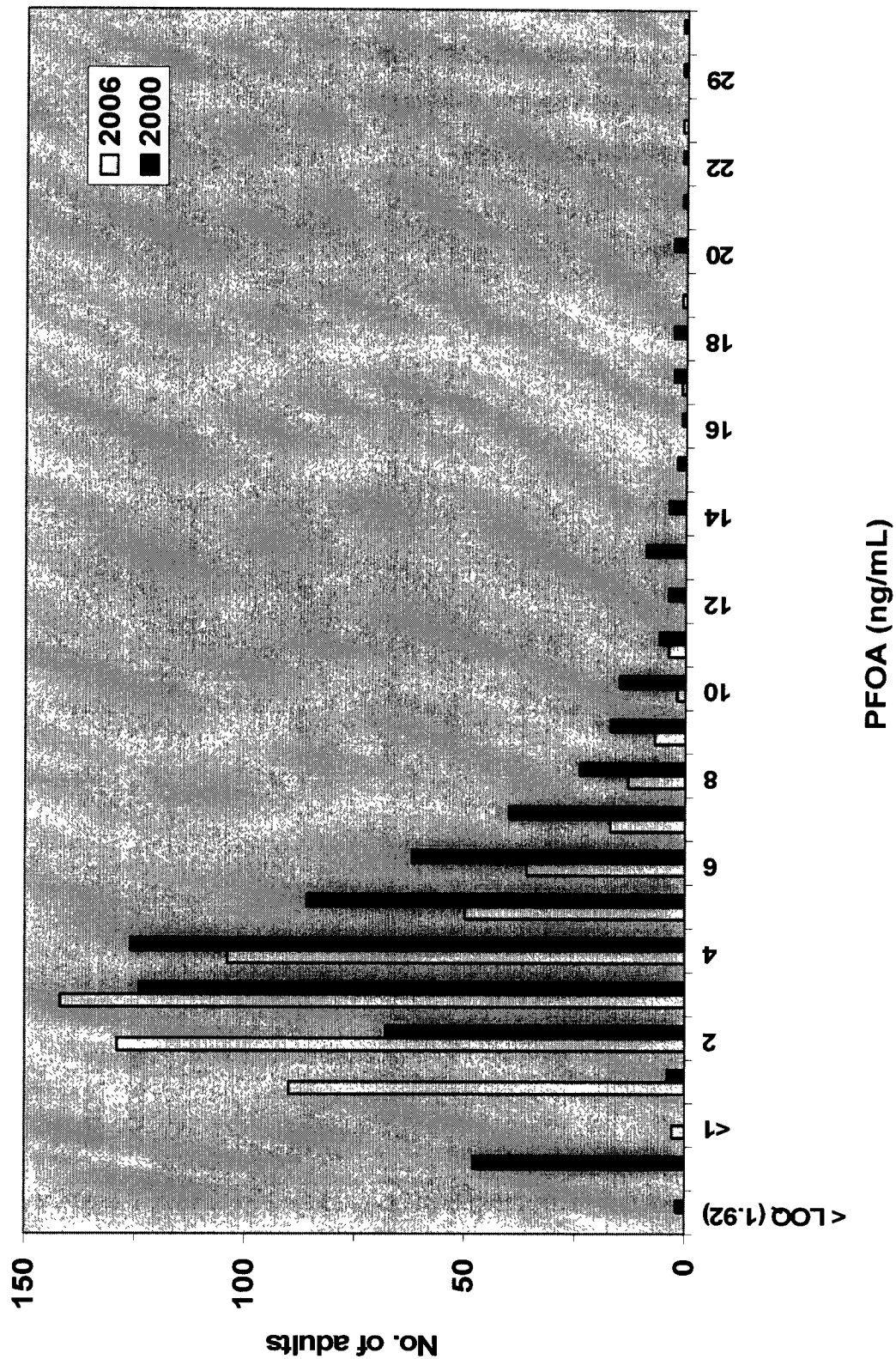
# Methods

- Analytical
  - PFOS (perfluorooctanesulfonate,  $\text{C}_8\text{F}_{17}\text{SO}_3^-$ )
  - PFOA (perfluorooctanoate,  $\text{C}_7\text{F}_{15}\text{CO}_2^-$ )
  - PFHS (perfluorooctanehexanesulfonate  $\text{C}_6\text{F}_{13}\text{SO}_3^-$ )
  - PFBS (perfluorobutanesulfonate,  $\text{C}_4\text{F}_9\text{SO}_3^-$ )
  - Me-PFOA-AcOH  
(N-methyl perfluorooctanesulfonamidoacetate,  
 $\text{C}_8\text{F}_{17}\text{SO}_2\text{N}(\text{CH}_3)\text{CH}_2\text{COO}^-$ )
  - Et-PFOA-AcOH  
(N-ethyl perfluorooctanesulfonamidoacetate,  
 $\text{C}_8\text{F}_{17}\text{SO}_2\text{N}(\text{CH}_2\text{CH}_3)\text{CH}_2\text{COO}^-$ )

# Distribution of PFOS Concentrations (ng/mL), American Red Cross Blood Donors, 2000 - 2006

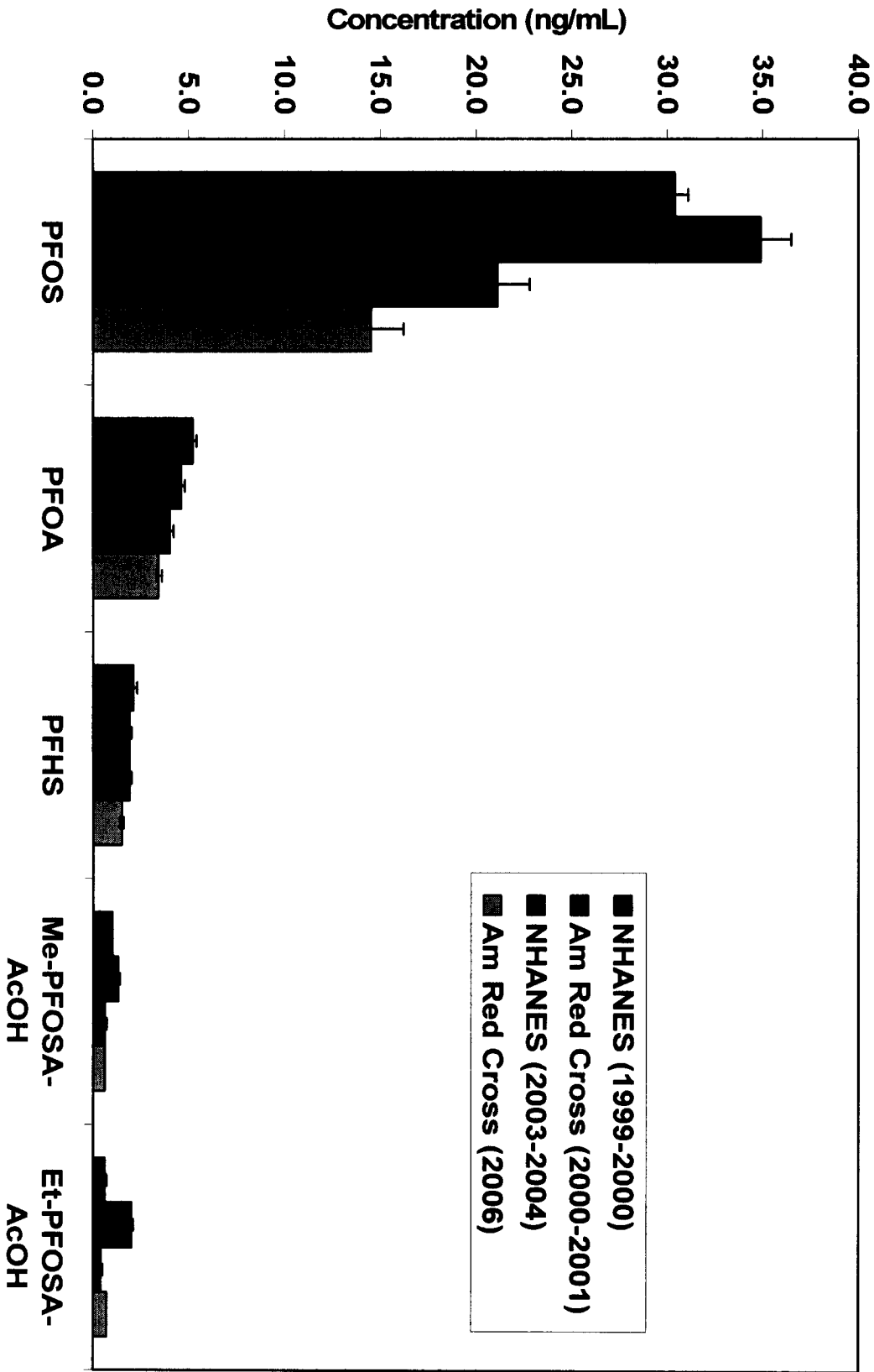


# Distribution of PFOA Concentrations (ng/mL), American Red Cross Blood Donors, 2000 - 2006



# Geometric Mean (95% CI) Concentrations CDC NHANES and American Red Cross Studies, 1999-2006

Calafat et al. ES&T 2007;41:2237-2242  
Olsen et al. EHP 2003;111:1892-1901  
Calafat et al. EHP 2007;115:1596-1602  
Olsen et al. ES&T 2008;42:4989-4995



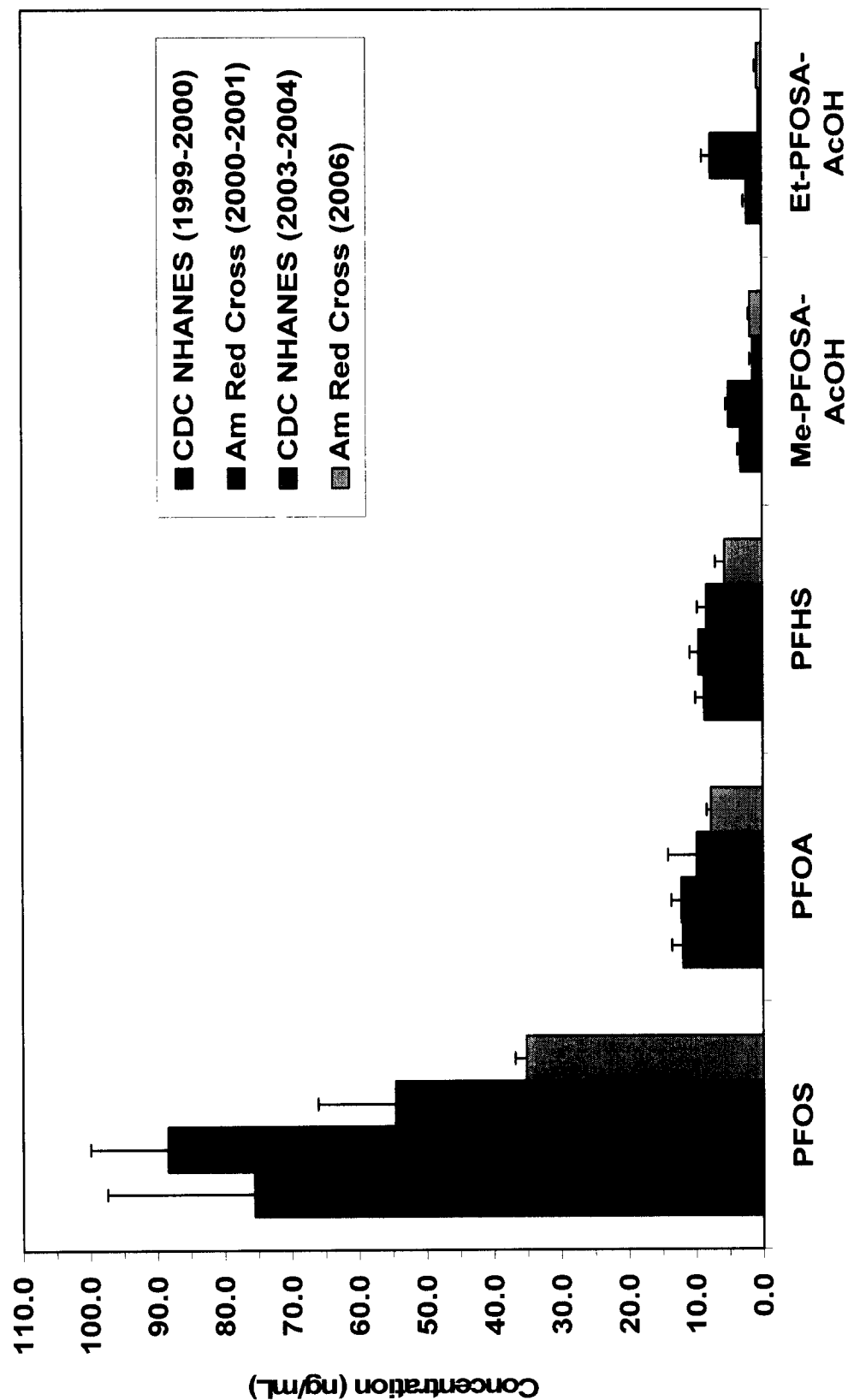
# 95<sup>th</sup> Percentile (upper bound), CDC NHANES and American Red Cross Studies, 1999-2006

Calafat et al. EST 2007;41:2237-2242

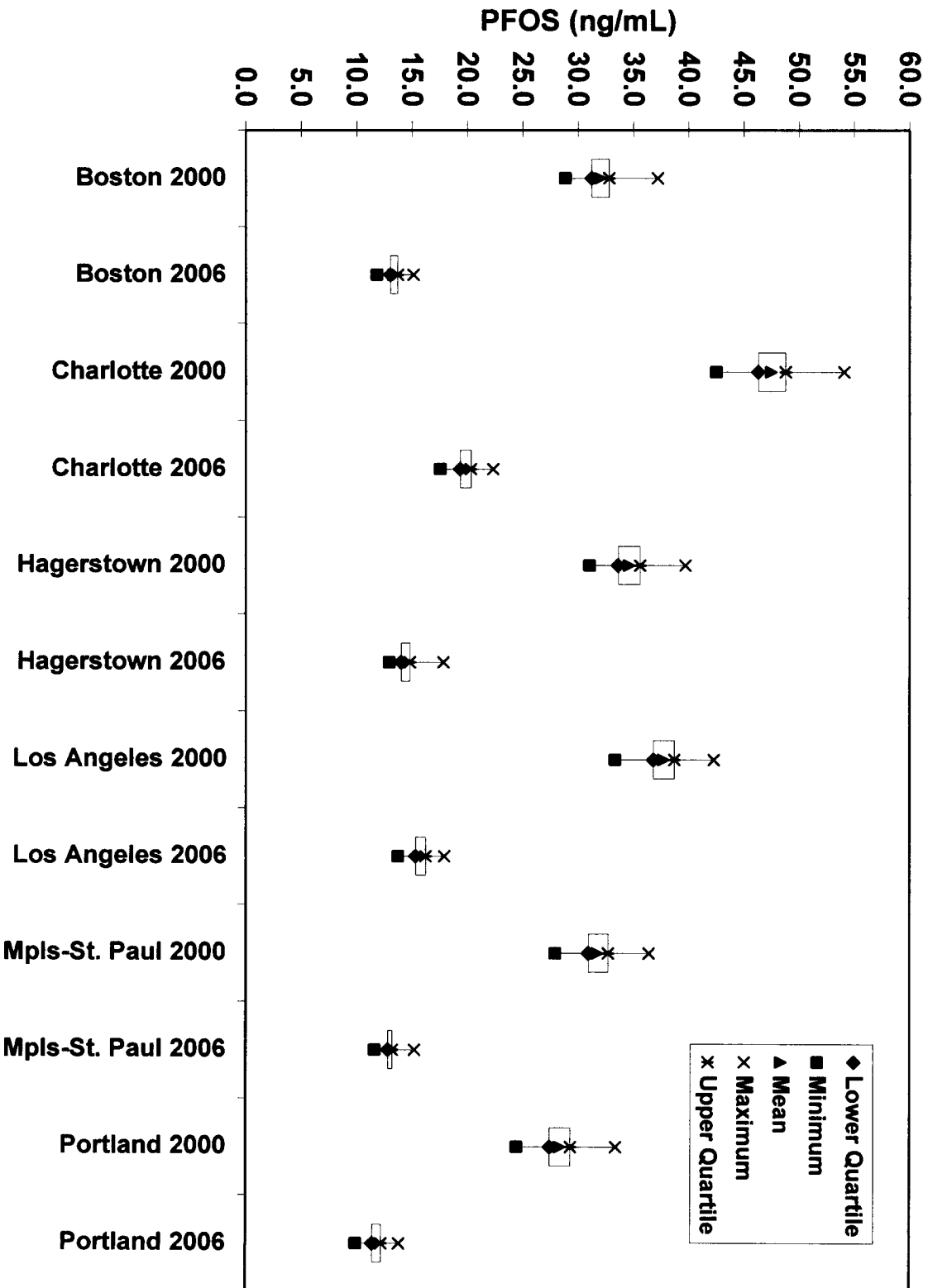
Olsen et al. EHP 2003;111:1892-1901

Calafat et al. EHP 2007;115:1596-1602

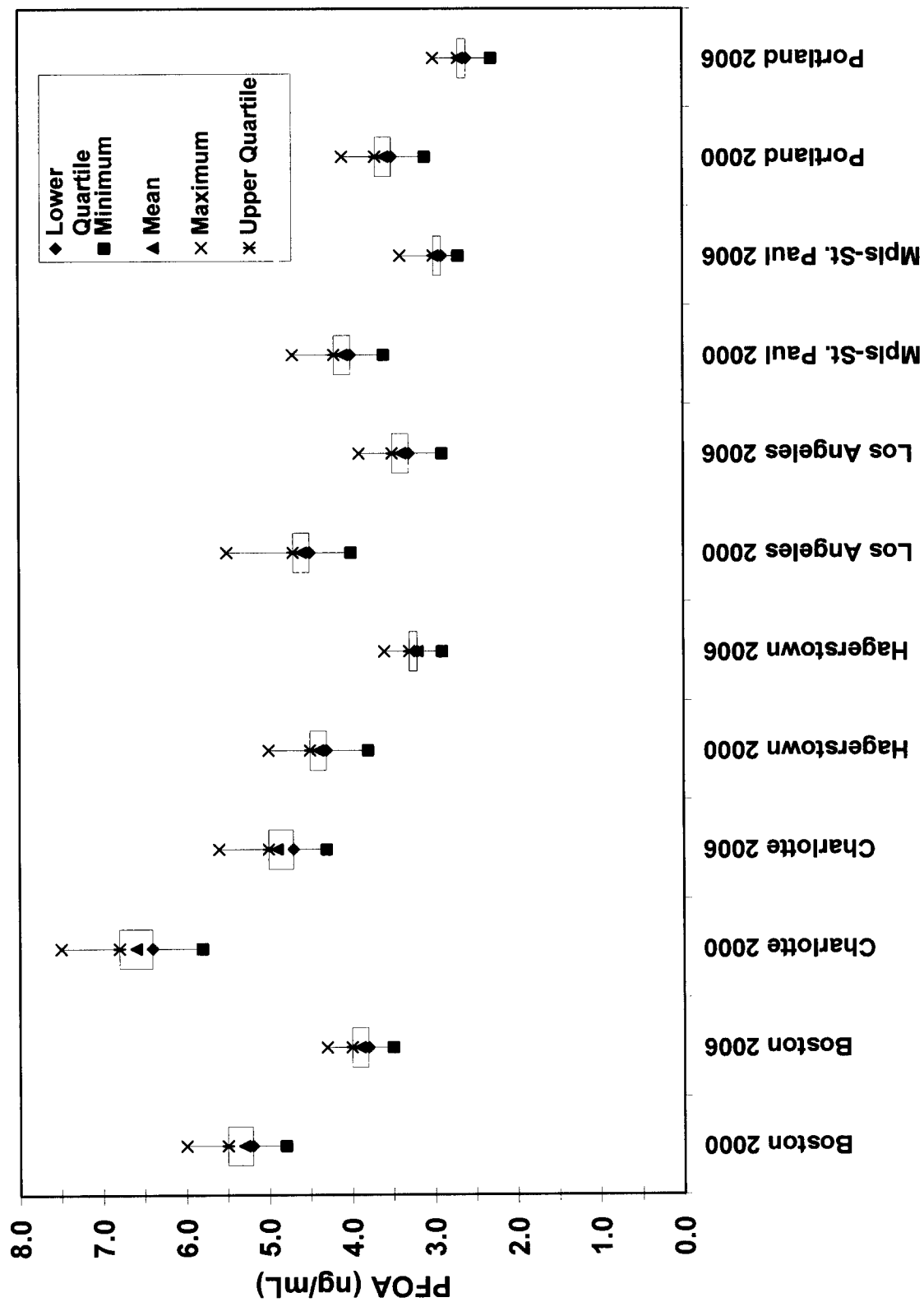
Olsen et al. ES&T 2008;42:4989-4995



# Age- and Sex-Adjusted **PFOS** Concentrations (ng/mL), American Red Cross Blood Donors, 2000 - 2006, by Six Geographical Locations



# Age- and Sex-Adjusted PFOA Concentrations (ng/mL), American Red Cross Blood Donors, 2000 - 2006, by Six Geographical Locations



# Methods

## Current Analysis

- Target Analytes
  - PFBA (perfluorobutanoate,  $C_3F_7CO_2^-$ )
  - PFPeA (perfluoropentanoate,  $C_4F_9CO_2^-$ )
  - PFHxA (perfluorohexanoate,  $C_5F_{11}CO_2^-$ )
  - PFHpA (perfluorheptanoate,  $C_6F_{13}CO_2^-$ )
  - PFOA (perfluorooctanoate,  $C_7F_{15}CO_2^-$ )
  - PFNA (perfluorononanoate,  $C_8F_{17}CO_2^-$ )
  - PFDA (perfluorodecanoate,  $C_9F_{19}CO_2^-$ )
  - PFUnA (perfluoroundecanoate,  $C_{10}F_{21}CO_2^-$ )
  - PFDoA (perfluorododecanoate,  $C_{11}F_{23}CO_2^-$ )

# Methods

- Analytical
  - Target analytes extracted by protein precipitation in acetonitrile
  - Perfluoro-*n*-[1,2,3,4-<sup>13</sup>C]octanoic acid spiked into all samples and the matrix-matched fetal bovine serum calibration curve prior to extraction for use as an internal standard
  - Quantitation accomplished by HPLC/MS/MS using Applied Biosystems MDS Sciex API 5000 triple quadrupole mass spectrometer

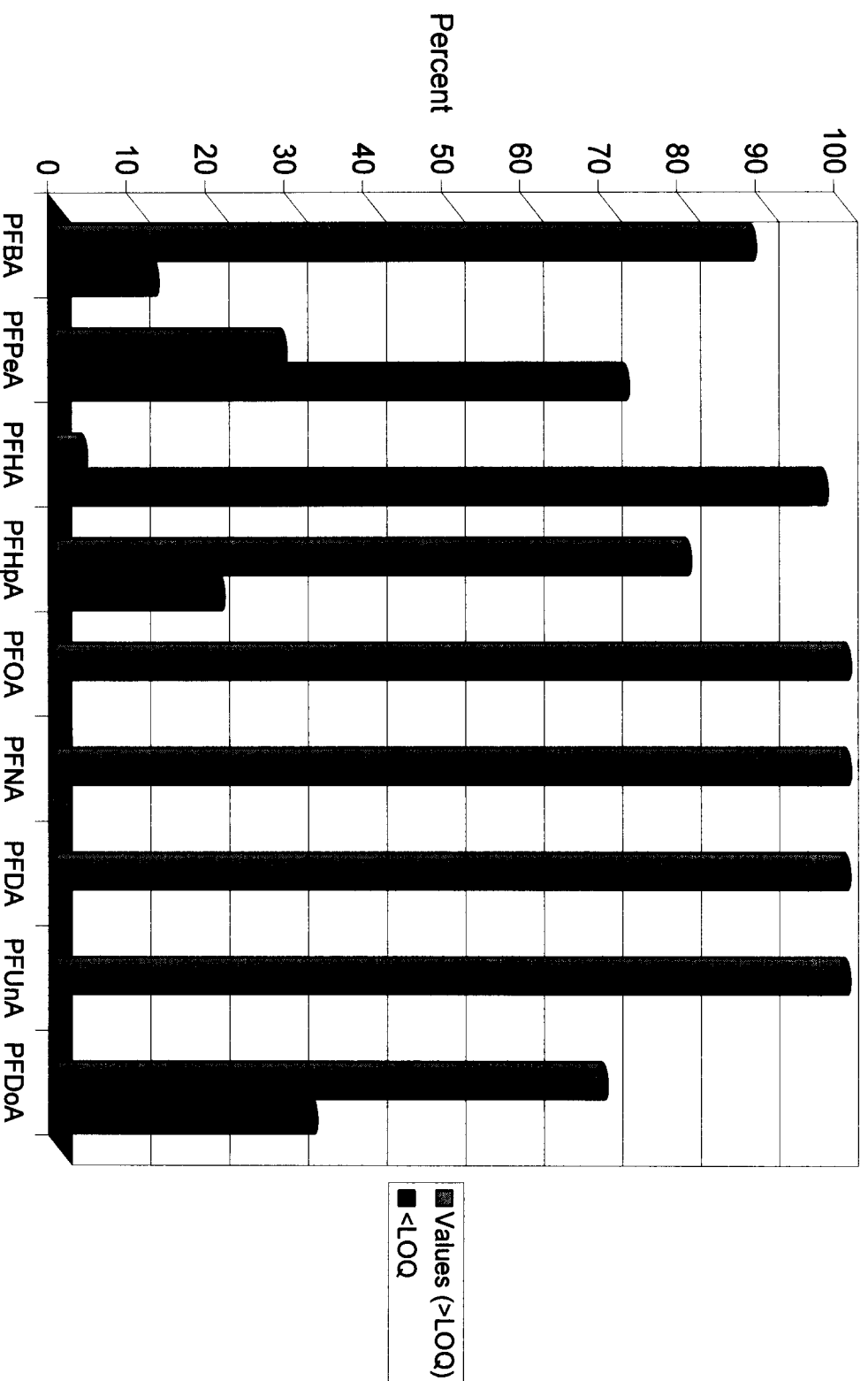
# Methods

- **Analytical**
  - **Quality control elements for each batch of samples extracted**
    - **Spiked control human plasma at two levels**
    - **Spiked control bovine serum at three levels**
    - **MPFBA, MPFDA, and MPFDOA spiked into each sample pre-extraction to determine extraction efficiency**
    - **MPFOA spiked into each sample pre-extraction as an Internal Standard**
  - **Matrix-matched calibration curve and solvent calibration curve prepared with each batch**

# Methods

- Analytical
  - Quality assurance
    - Split samples (n = 60)
    - Reanalysis of 2000 Am Red Cross serum samples (n = 78) using 2006 methods

# American Red Cross 2006 Plasma Samples (N = 600), Percent Above (blue) and Below (red) LOQs



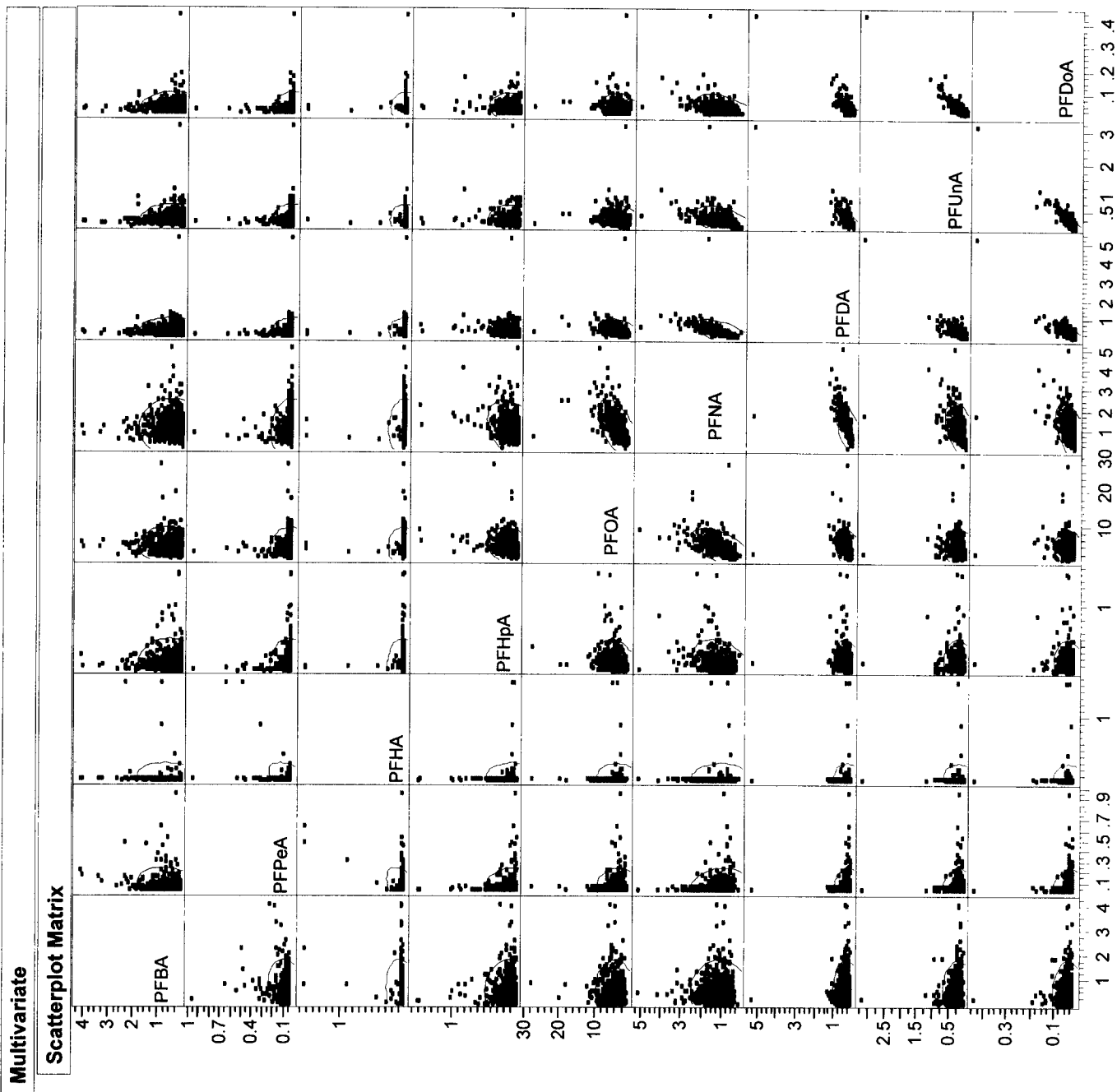
American Red Cross 2006 (N = 600),  
Measures of Central Tendency in Plasma Concentrations  
(ng/mL)

|       | Arithmetic<br>Mean | Geometric<br>Mean | Range        |
|-------|--------------------|-------------------|--------------|
| PFBA  | 0.80               | 0.33              | 0.04 – 8.63  |
| PFPeA | 0.07               | 0.06              | 0.03 – 0.96  |
| PFHA  | 0.07               | 0.06              | 0.04 – 1.53  |
| PFHpA | 0.14               | 0.09              | 0.02 – 2.030 |
| PFOA  | 4.40               | 3.44              | 0.78 – 53.70 |
| PFNA  | 1.04               | 0.97              | 0.12 – 5.10  |
| PFDA  | 0.36               | 0.34              | 0.05 – 5.270 |
| PFUnA | 0.22               | 0.18              | 0.02 – 3.17  |
| PFDoA | 0.04               | 0.03              | 0.04 – 0.44  |

Comparison of CDC NHANES 2003-2004 (Serum) and  
American Red Cross 2006 Plasma Concentrations (ng/mL):  
Geometric Means with 95% CI (or Median when LOD)

| <u>Compound</u> | <u>CDC*</u>     | <u>Am Red Cross (95% CI)</u> |
|-----------------|-----------------|------------------------------|
| PFHpA           | <0.3 (LOD)      | 0.09 (0.08-0.09)             |
| PFOA            | 3.9 (3.6 – 4.3) | 3.44 (3.30-3.59)             |
| PFNA            | 1.0 (0.8 – 1.1) | 0.97 (0.93-1.05)             |
| PFDA            | <0.3 (LOD)      | 0.34 (0.33-0.35)             |
| PFUnA           | <0.3 (LOD)      | 0.18 (0.17-0.19)             |
| PFDoA           | <1.0 (LOD)      | 0.03 (0.03-0.04)             |

\*Calafat et al. EHP 2007





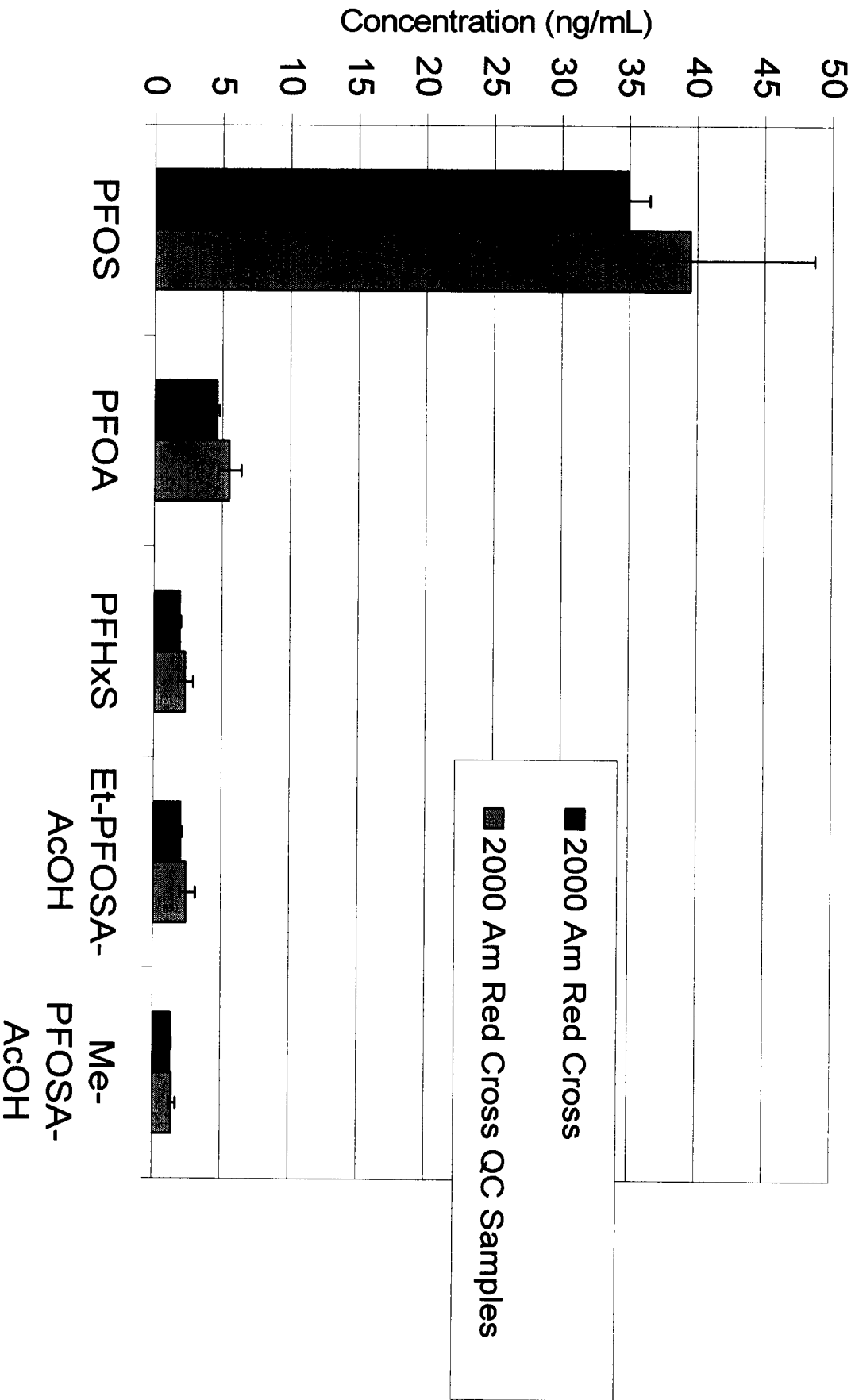
# Multivariate

## Correlations

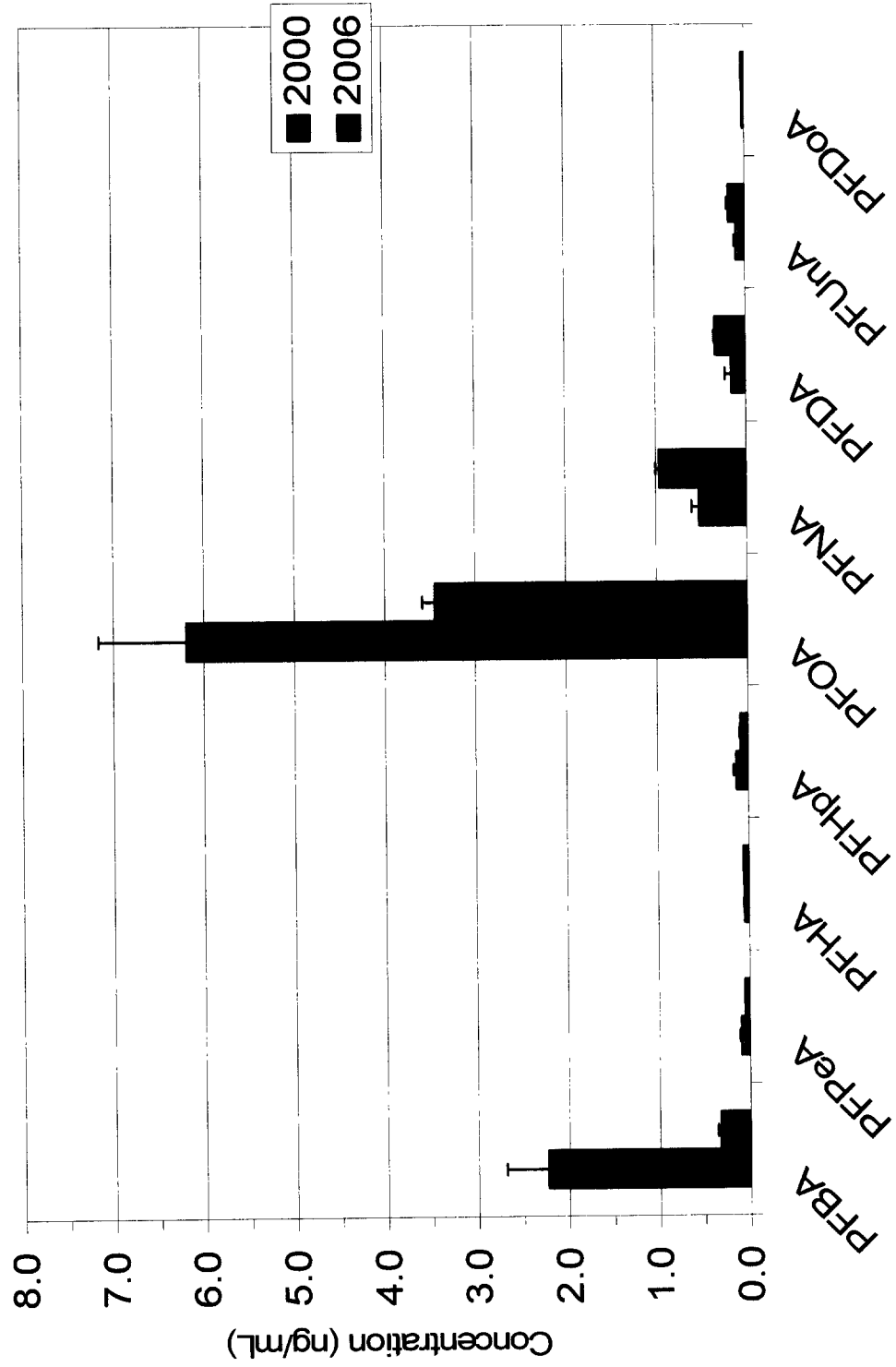
|          | In PFBA | In PFPeA | In PFHA | In PFHpA | In PFOA | In PFNA | In PFDA | In PFUnA | In PFDoA |
|----------|---------|----------|---------|----------|---------|---------|---------|----------|----------|
| In PFBA  | 1.0000  | 0.2648   | -0.0239 | 0.0701   | 0.0781  | 0.0887  | 0.0450  | 0.0116   | 0.0660   |
| In PFPeA | 0.2648  | 1.0000   | 0.0715  | -0.1117  | -0.1463 | -0.1941 | -0.2156 | -0.1129  | -0.1709  |
| In PFHA  | -0.0239 | 0.0715   | 1.0000  | 0.0431   | 0.0222  | -0.0026 | 0.0249  | 0.0689   | 0.0702   |
| In PFHpA | 0.0701  | -0.1117  | 0.0431  | 1.0000   | 0.4406  | 0.3773  | 0.3635  | 0.1451   | 0.1780   |
| In PFOA  | 0.0781  | -0.1463  | 0.0222  | 0.4406   | 1.0000  | 0.6805  | 0.5580  | 0.2884   | 0.2605   |
| In PFNA  | 0.0887  | -0.1941  | -0.0026 | 0.3773   | 0.6805  | 1.0000  | 0.8538  | 0.6334   | 0.5563   |
| In PFDA  | 0.0450  | -0.2156  | 0.0249  | 0.3635   | 0.5580  | 0.8538  | 1.0000  | 0.7281   | 0.7164   |
| In PFUnA | 0.0116  | -0.1129  | 0.0689  | 0.1451   | 0.2884  | 0.6334  | 0.7281  | 1.0000   | 0.8250   |
| In PFDoA | 0.0660  | -0.1709  | 0.0702  | 0.1780   | 0.2605  | 0.5563  | 0.7164  | 0.8250   | 1.0000   |

# 2000 American Red Cross Serum Samples (N = 645) Compared to 2000 QC Reanalyzed w/ 2006 (N = 78):

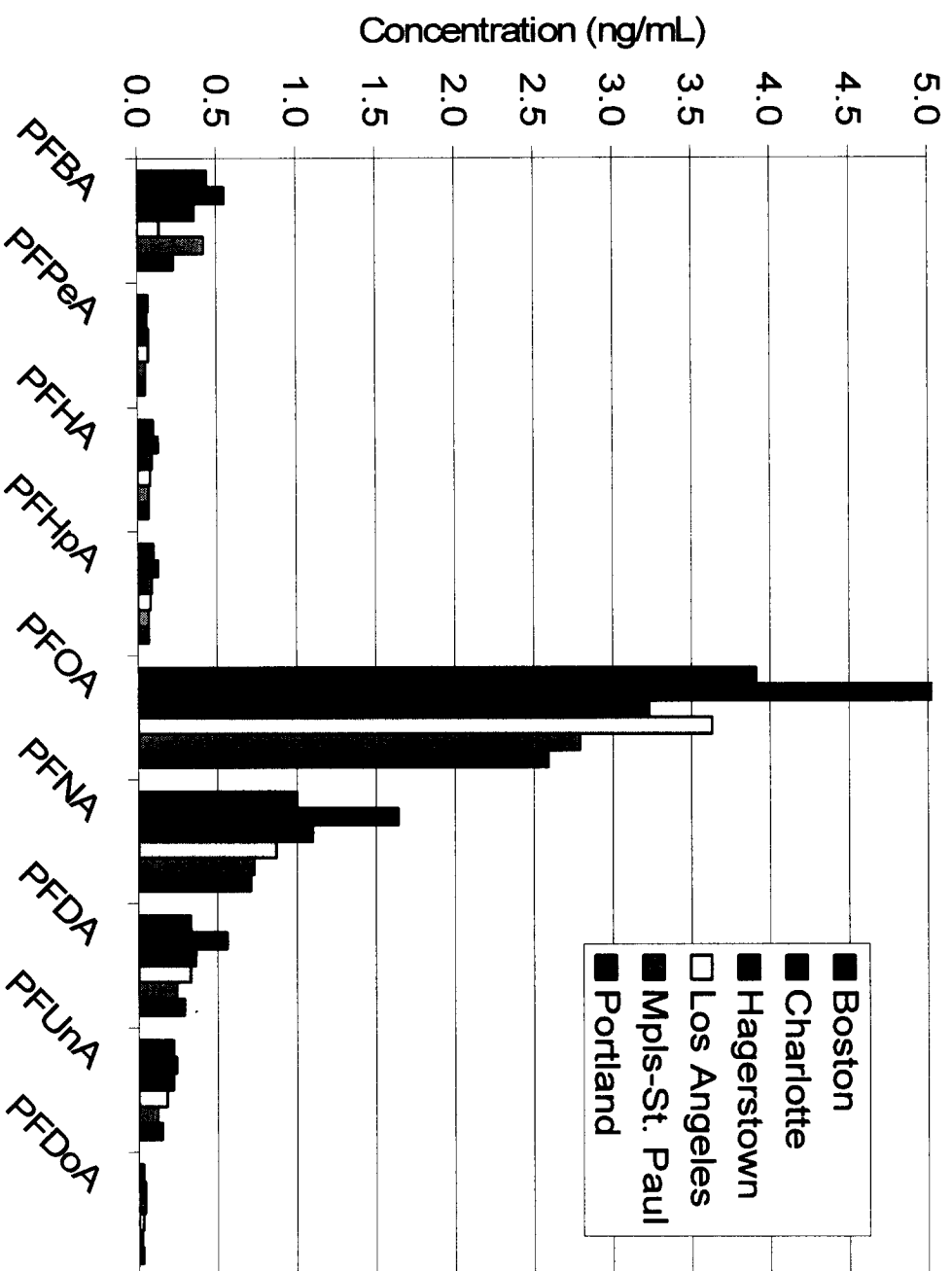
## Geometric Means (95% CI)



2000 American Red Cross  
QC Serum Samples (N = 78) vs 2006  
Plasma Samples (N = 600): Geometric Mean (95% CI)



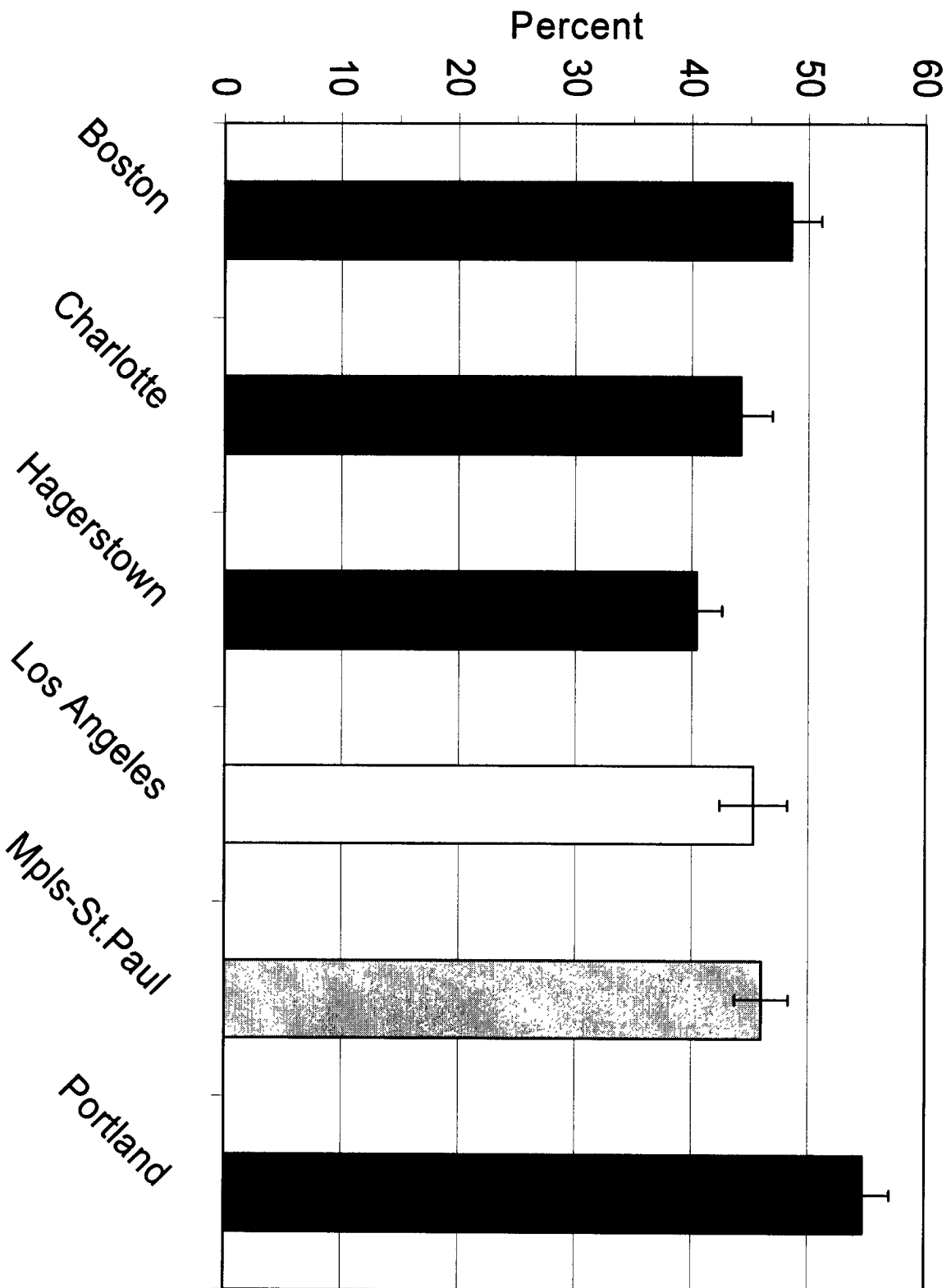
# 2006 American Red Cross Plasma Samples (N = 600) by Location: Geometric Means



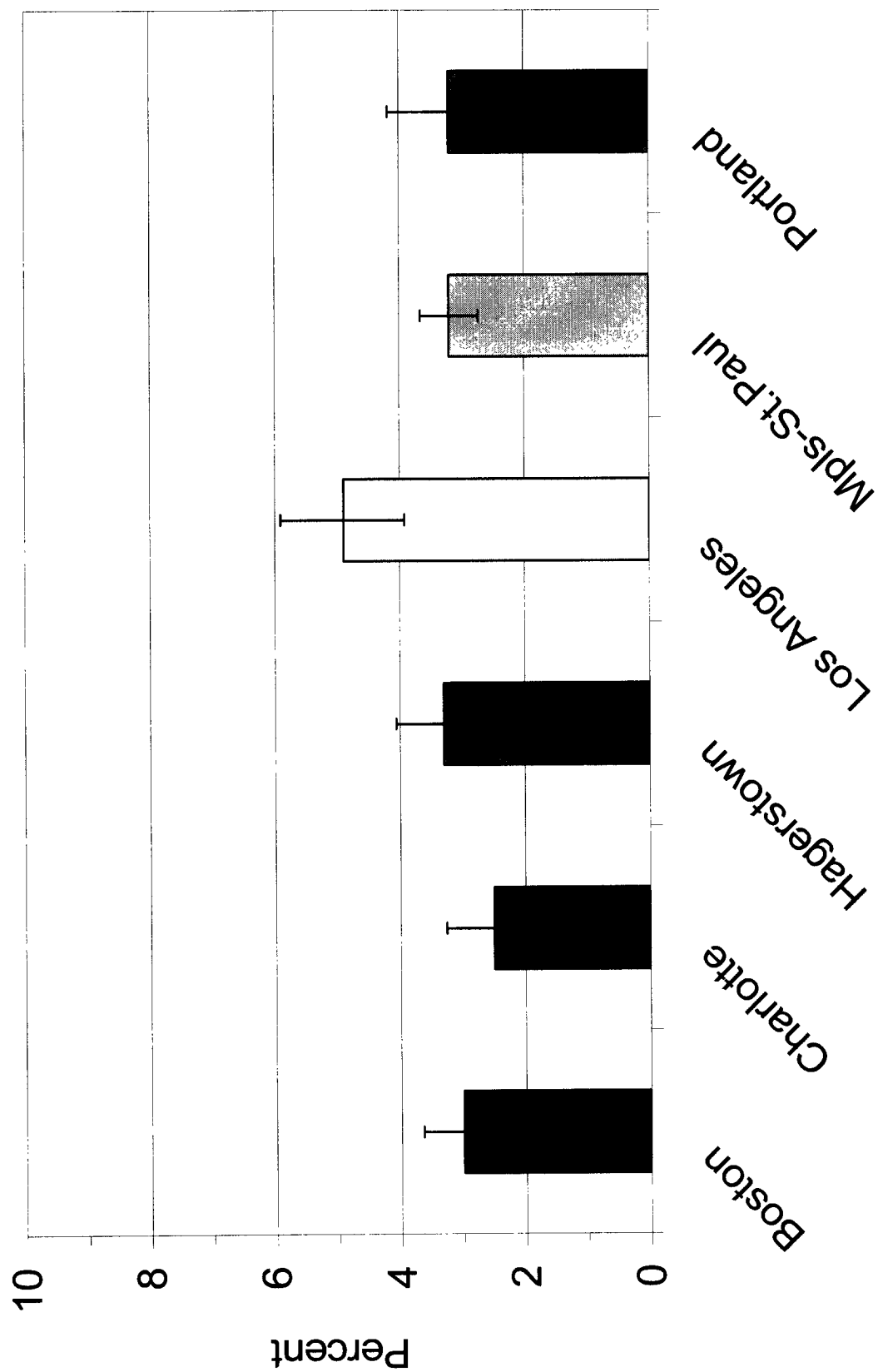
# 2000 American Red Cross QC Serum Samples (N = 78) vs. 2006 Plasma Samples (N = 600): Percent Branched PFOS & PFOA



# 2006 American Red Cross Plasma Samples (N = 600): Percent Branched PFOS, by Location



# 2006 American Red Cross Plasma Samples (N = 600): Percent Branched PFOA, by Location



# Serum Elimination Half-lives in Humans

## Geo Mean

| <u>Compound</u> | <u>Half-life</u> | <u>95% CI</u> | <u>Reference</u>          |
|-----------------|------------------|---------------|---------------------------|
| PFBA            | 2.7 days         | 1.9 – 3.8     | Chang et al. Tox Sci 2008 |
| PFOA            | 3.5 yrs          | 3.0 – 4.1     | Olsen et al. EHP 2007     |
| PFBS            | 25.8 days        | 16.6 – 40.2   | Olsen et al. Toxicol 2008 |
| PFHxS           | 7.3 yrs          | 5.8 – 9.2     | Olsen et al. EHP 2007     |
| PFOs            | 4.8 yrs          | 4.0 – 5.8     | Olsen et al. EHP 2007     |

# Summary

## American Red Cross Studies

### 2000 - 2006

- **PFOS**
  - **Approximate 60 percent decline in PFOS serum concentrations between 2000 and 2006. No change in ratio of linear to branched isomers from 2000 to 2006**
  - **Comparable percentage declines across age, sex, and locations**
  - **Consistent with serum elimination half-life of PFOS and phase-out time period**
    - **Long half-life likely due to saturable renal resorption**

## Summary (continued)

- **PFBA**
  - **Average plasma concentrations of  $\approx 2$  ng/mL in 2000; 85% reduction by 2006**
- **PFPeA**
  - **majority of 2006 values < LLOQ**
- **PFHA**
  - **majority of 2006 values < LLOQ**
- **PFHpA**
  - **34% reduction in average concentration from 2000 to 2006; 1/3 values < LOQ in 2006**

## Summary (continued)

- **PFOA**
  - **Decline in PFOA concentrations was also observed but lower percentage than PFOS.**
  - **2000 samples had an average of 5.3% branched PFOA while samples from 2006 contained 3.2% branched PFOA isomers.**
  - **Suggests PFOA can not be solely attributed to POSF-based production activities despite the strong correlations between PFOS and PFOA**
    - **Half-life of PFOA is less than PFOS**

## Summary (continued)

- **PFNA**
  - **≈ 100% increase in average concentration from 2000 to 2006. Consistent with CDC findings.**
- **PFDA**
  - **≈ 100% increase in average concentration from 2000 to 2006**
- **PFUnDA**
  - **≈ 80 % increase in average concentration from 2000 to 2006**
- **PFDnOA**
  - **Majority of 2006 values < LLOQ**

## Summary (continued)

- Strong Correlations
  - Observed between higher chain perfluorocarboxylates

**PFOA/PFNA**

**PFNA/PFDA**

**PFDA/PFUnA**

**PFUnA/PFDoA**

## Summary (continued)

- **Weak Correlations**
  - **Observed between higher chain and lower chain perfluorocarboxylates**